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Application of geomorphology in urban planning: Case study in landfill site selection

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Abstract

In this paper, we study the application of geomorphology in planning. Since geomorphology is a science about the changes in land features and geomorphic planning is a science that helps us find the best solutions for present land use problems. Geomorphology uses different time scales for planning issues. Short term time scaling includes a 10 to 50 year period through which this science can play a significant role in issues such as site selection of many land uses. Urban site selection, urban morphology, industrial and waste disposal site selection are among these land uses. We have carried out research for a solid waste disposal site selection as a case study and the city of Bonab has been chosen as the study region. This city has located in the southern part of East Azerbaijan Province, at 46':52" eastern longitude and 37':20" northern latitude. The topographic situation of the region, ecologic and economic problems with the current location of the waste disposal site (such as its neighboring with faults, its proximity to surface waters and industrial establishments and the steep slope of the area) have been the reasons of study. These issues necessitate thorough investigations for waste disposal site selection in this region. The focus of this research is on demonstrating the application and the importance of geomorphic studies in planning. We have considered geomorphic factors and sub-factors like rock, soil, slope, faults and unstable lands. In addition, ecologic and socio-economic factors and the element of hydro-climate have also been considered. Using digital maps of the region and GIS software (Arc View and ArcGIS), we have tried to determine the most appropriate waste disposal site with the least ecological, social and economic threats. Using this method, we have selected 9 appropriate sites for waste disposal. The aim was choosing an optimum solid waste site. The site proposed is located on the south-east of the city, 7 km from Malekan.

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Keywords: Geomorphology; Site Selection; Urban planning; Urban Waste; Landfill; Bonab.

1. Introduction

Geomorphology is one of the basic policies of urban planning, as a result of this, issues of cities need geomorphological planning. To achieve goals such as reduction in natural disasters and improvement in life's quality, geomorphological planning is recommended. Geomorphological planning is a vigilant action which provides the best morphological solution. That is to determine the best position to establish lasting monuments and other valuable places [1].

In geomorphological planning natural phenomena (geomorphology) sometimes act as a negative factor and sometime act as a positive factor; through site selection process Dynamism of natural environment such

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as flood, earthquake, wind, faults and slope must be highly considered [2].

In this survey landfill sites are selected as one of the urban issues and we tried to choose the best place for landfill using geomorphological knowledge. Site selection and finding appropriate place for landfill is one of the most important parts of municipal solid waste management system and on the other hand, geomorphology science, considering its nature which is concerned with source and change of earth shapes and their formation process or combination of constitutive materials, [3] has an important role in site selection. Several factors are involved in choice of appropriate place for sanitary landfill of municipality solid waste that each of them is important enough not to be omitted and determines limitations in site selection. The most important of these factors are geomorphology related factors such as: bedrock, unstable lands, soil, fault, slope and geohydrology. In addition to the geomorphology criteria, other different factors such as depth of groundwater, climate condition, environmental factors, road network, land use and etc. are also involved in landfill site selection. The ultimate purpose is finding the best place with the less adverse effects on the natural environment around the landfill site.

2. Study area

The study area for landfill site selection is Bonab. This city is located in the southern part of east Azerbaijan province in Iran; at 46':52" eastern longitude and 37':20" northern latitude. This city has historical and cultural background. The population of Bonab is 70,000. Today, due to existence of good weather, university and job opportunities, this city has become the center of population in area [4]. Population growth and change in consumption pattern have caused the increase of trash production of city.

There is no suitable method for Bonab's waste disposal. As shown in fig. 1, currently solid waste of city accumulates on the ground surface at different points around the city

Fig. 1. Accumulation of city solid waste

Fig. 2. Accumulation of leachate and pollution of groundwater and surface water

These places have been chosen without research and knowledge about right parameters that have effects on finding healthy landfill site; so these places respond to be only a temporary solid waste landfill centers. On the other hand, locating the sanitary center for landfill site selection due to natural and environmental characteristics of city is very painstaking and complex.

The topographic situations of the region, ecologic and economic problems with the current location of the waste disposal site (such as its location on faults, its proximity to surface waters and industrial establishments and the unsuitable slope of the land in the region) are problematic issues. These issues necessitate waste disposal site selection in this region through investigations [5].

3. Materials and Methods

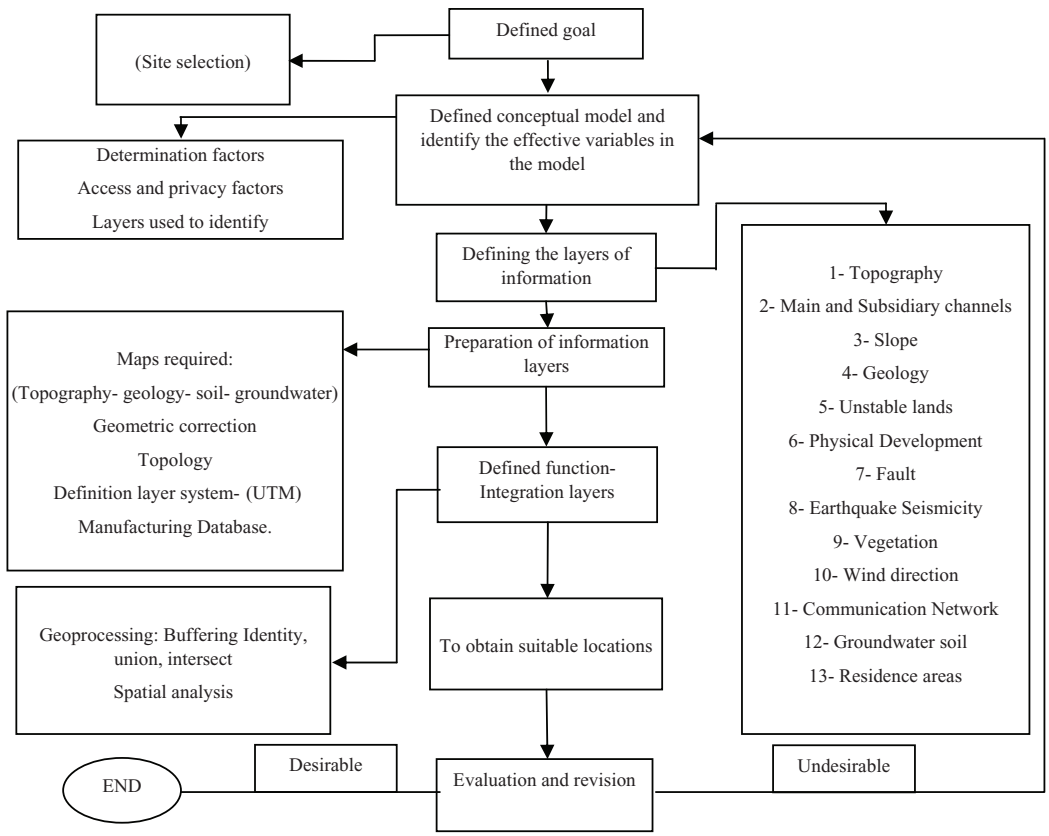
Considering the subject of research, first, we have used descriptive-historical research to study theoretical topics based on experimental data. Then, we have used applied research method for studying and evaluating complete case study. In next stage, based on the theoretical and empirical study, we have evaluated issues related to municipal solid waste are effective factors in site selection sanitary landfill, natural, climatic and structural characteristic,. At the final stage, after analysis of all the factors as experimental, we proceeded site selection of sanitary landfill of municipal solid waste in the Bonab with using the GIS and digital maps of Bonab, that shown in Table 1. [6]

Since the site selection of sanitary landfill of municipal solid waste involved vast information, geomorphologist would face many information and parameters.

Therefore, the perfect site selection of landfill needs data acquisition and processing them to determine the appropriate place. It is time-consuming, expensive or perhaps impossible to use large amount of information, acquisition, processing and saving information in site selection of landfill manually.

This matter force planners and Geomorphologist to use new computer tools exactly GIS. Nevertheless, in the present place of landfill in Bonab, landfill method is traditional and open and some of environmental criteria are not concerned. So this matter caused pollution of groundwater and surface water sources, air pollution and loss of biological balance life in this area. It is a big problem; therefore, paying attention to site selection of sanitary landfill is a requirement in Bonab.

Table 1. Flowchart of Process for find suitable place for Bonab solid waste landfill site selection



4. Discussion

Disposal of solid waste always have been one of the primary problems of the municipal services [7]. Several factors are involved in optimal landfill site selection. In addition of that Location of Landfill site has direct effect on design, operation, utilization and type of facilities and equipment which might use. On the other hand, this site selection can be located under the programming environment and logistics land branch of science [8].

To locate landfill site, in the first step, criteria and standards of that must be identified and considered. (table 2).

In the next step, we need some parameters define to digital layers for using in ArcGIS software and doing necessary actions to find optimized places [9].

The focal point of this research is demonstrating the application and the importance of geomorphic studies in planning. We have considered geomorphic factors and sub-factors like rock, soil, slope, faults and unstable lands. In addition, ecologic and socio-economic factors and the element of hydro-climate have also been considered. Using digital maps of the region and GIS software (Arc View and ArcGIS), we have tried to determine the most appropriate waste disposal site with the least ecological, social and economic threats.

[10]

Table 2. Effecting region of sanitary landfill municipal solid waste parameters [11]

Site Selection Parameters	Properties
Slope	Must less than 30 degree
Groundwater	Depth must more than 10 meter
Surface water	Minimum: 600 m distance from the surface water
Wind direction	Must not to be in prevailing winds.
Precipitation	Placed in minimum rain fall
fault	minimum distance: 100m from faults and fractures
Soil	Impermeable soil is better, Silt clay unacceptable.
Bedrock	Igneous rocks, Sedimentary rocks, Metamorphic rocks and impermeable and dense without fault are suitable
Flood	Must not to be submergible
Topography	Must be in flat area
Depth of soil layers	Must greater than 10 meters depth
Distance from residential areas	least distance 4-5 and maximum distance 20 km from cities
Ecological sensitivity	Vegetation cover, wild life, protected area and rare species must not threatened.
Land use in future and now	Must be compatible with other uses of land in future and now
Landfill outspread	Must be use in 15 to 20 next years
Accessing Roads	Width of road must be more than 7 meters, the traffic of roads must be low
Privacy shield in natural landscape	It is better to be in the place with natural brakes
Infrastructural facilities	Water, electricity and other necessary facilities are provided.

With respect to effective parameters and their restrictions in site selection, first we must prepare the digital layers of table 1, parameters. Then related parameters digitized. These digital layers include:

- Topographic map of study area.
- Slope of study area
- Geology maps (fault and rock type)
- Soil type
- Population center
- Vegetation cover
- The network of roads
- Groundwater and surface water and so on

These digital layers are prepared in 1:25000 scale suitable for work in the ArcGIS software and desired functions can be imposed on them.

Series of action that imposed on the digital layers are listed below:

- **Geometric Correction:** Geometric correction purpose is adjustment of exiting phenomenon over map with reality in ground. After scan, paper maps are without coordinate system. Therefore it is necessary to identified (x, y) of map quadrangle with respect to georefrenced methods were identified and then saved with used format in system. For having done the job, it is necessary to have control points. With using control point we can estimate other existing pixels upon scanned map. This work named resembling. Digital maps have (x, y) coordinate.
- **Topology:** the mean of topology is that we can create location relationship between geographical phenomenon and real world at GIS map. Digital map should change to raster format. At raster state relationship between cells and its neighborhood are next to each other. Given cells dimension and first cell coordination, other cells coordinates identified.
- **Project system**: project system is a mathematical change for presentation of circular surface over flat map. Different data layers which used in GIS environment should presented with same project system. Since site selection is a painstaking and precise action determining of distance and accurate location of phenomenon characterize project system of maps is essential. UTM Project system and maps ellipsoid of WGS84 UTM zone 38 was selected.
- **Informational layer structure and entering information to GIS environment**: After these steps, it is essential to have exiting phenomenon upon maps as database which were saved in system. Thus, first Geo data base at GIS environment was defined and then in Geo data base requirement informational layers at

UTM project system was defined.

Buffer Distance: Function was used for determining phenomenon buffer which using information mentioned at table and buffer distance informational layers were extracted.

- Fault buffer
- Buffer from surface water
- Buffer from roads
- Buffer from area with vegetation cover
- Buffer from power lines

Geomorphologists role in urban planning can be summarized as: perfect recognition of area, current geomorphological processes assessment, future geomorphological processing forecasting. [12]

5. Results

After perfect interpretation of landfill site selection now we can perform it in Bonab area. For do this, first mentioned standards and limits upon digital layers should applied for finding permissive locations. After incorporation layers together and observing necessary standards locations which have idealistic condition were recognized. From these locations those which have area less than 27.5 hectare were eliminated and others were divided to 9 primary regions. These regions were numbered in.

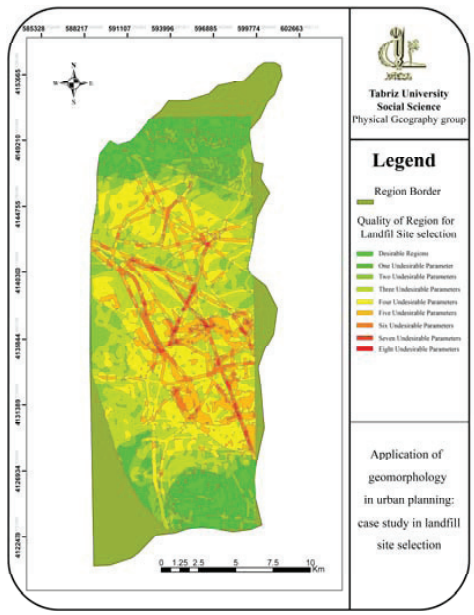


Fig. 3. Result of compose of effective layers on landfill site selection.

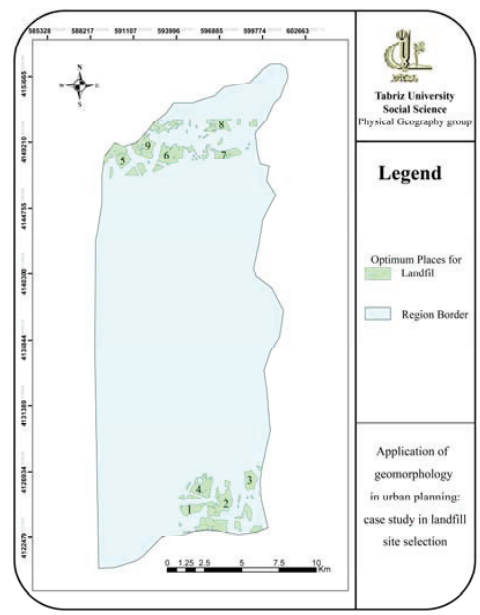


Fig. 4. Suitable places for selecting landfill site

6. Conclusion

With respect to final map, suitable locations for landfill sites were identified. These locations set of factors (geomorphological, environmental, hydrological and economical) were determined with spatial differences in the frame of different informational layers in model with using Arc GIS software were analyzed.

These research findings clearly show the use of geomorphology science in addressing the problems in urban planning. Often geomorphological processes do not show themselves in normal condition and they remain invisible and a change in the condition causes an unpleasant event.

It should be considered that environmental effects and loss of lives and financial damages to rural and urban area due to lack of attention to knowledge and geomorphic information at urban planning is more sensible in case of damages and catastrophes.

Nowadays geomorphology in urban issues is more important and role of geomorphology directors in industrial and residual centers urban site selection is not ignorable.

References

[1] Motamed A, Moghimi. Application of geomorphology in urban planning, samt, 1998
[2] Negaresh H. Application of geomorphology in site selection cities and consequences it, Geography and development, 1999
[3] Mahmoudi F. structural geomorphology, payam noor university, 2002.
[4] Rajabi M. Geomorphology and cities, case study Bonab city. Journal of Faculty of social science, University of Tabriz, 1992.
[5] Emery A, Davies A, Environmental and economic modelling: A case study of municipal solid waste management scenarios in Wales, 2006
[6] Moghimi A, Mahmoudi F., Research Methodology in the Natural Geography (Geomorphology). Gomes, 2004.
[7] Monavari M., Environmental impact assessment model for urban landfill sites, Organization and into recycle materials, Tehran Municipality, 2002.
[8] Sorkhi V., sanitary landfill municipal solid waste using GIS, Tarbiyat Moalem University, 2005.
[9] Ghose, M.K, A.K. Dikshi., A GIS based transportation model for solid waste disposal – A case study on Asansol municipality, 2006.
[10] Massarutto, A., Municipal waste management as a local utility: Options for competition in an environmentally-regulated industry, 2006.
[11] Heydarzade N., site selection sanitary landfill municipal solid waste using, 2001.
[12] Nadersefat M., Urban geomorphology . pay am nor university , 2008.